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INTRODUCTION

This article studies the transformation processes occurring in industry and business at large. It deals with the social and economic challenges, and explores the new concepts arising from an unprecedented technology revolution underpinned by advances and innovation in ICT. In addition it sets the scene for a new era of industrial capitalism.

Over the last decade of the twentieth century, a large number of companies faced the future with trepidation while others lacked a good strategy (Possl, 1991; Kidd, 1994; Ashkenas, 1997). Many changes had taken place including Just In Time (JIT) manufacturing and logistics, lean manufacturing (Womack, Jones, & Roos, 1990), shorter product lifecycles (Davenport, 1993), more intelligent approaches to IT (Drucker, 1992; MacIntosh, 1994; Nonaka, 1998), and costing (Wilson, 1995; Ansari, Bell, & the CAM-I Target Cost Core Group, 1997), but making money was becoming more and more difficult. It was a time and climate for dramatic new approaches (Warnecke, 1993; Drucker, 1994; Goldman, Nagel, & Preiss, 1995) with greater agility. New technologies were replacing old at a faster rate, and information technology provided better management and control vision, albeit on a limited local scale (Arguello, 1994; Leachman, Benson, Lui, & Raar, 1996; Makatsoris, Leach, & Richards, 1996). Also, push to pull manufacturing (Mertins, 1996) distinctly changed the approach to customers and service, which increased competitive and economic pressures resulted from the global reach of customers, manufacturers, and service providers keen to exploit the wealth of opportunities in both global markets and differences in worldwide regional markets (Bitran, Bassetti, & Romano, 2003). Even players only operating in local markets (Bologni, Gozzi, & Toschi, 1996; Zabel, Weber, & Steinlechner, 2000; Bonfatti & Monari, 2004) could not resist the tide of change. As a result many companies and economies (Hutton, 1995) were in a state of upheaval, and as a consequence some fell by the wayside. This was a climate in which there was an uncertain outcome, and it was into this melting pot that the Internet and the World Wide Web (WWW) were to produce an environment for a much-needed revolutionary change in the industrial approach.

Later, broadband for landline and also wireless networking provided a much-needed speedier access.

Businesses looked to the wider horizons and the dynamics of their supply chains as well as their markets to discover new ways of working with both customers and suppliers, to grow and remain viable. The diverse industrial, commercial, and operational practices and processes needed to be remolded. And the collaborative aspects of external relationships to the advantage of company performance and the creation of new opportunities were the ones to be targeted. This resulted in increasing use of new forms of communication and innovation in multimedia technologies. In this unsettled environment, once fear of change had been forced into the background, chaos became the domain of creative experimentation (Weiland-Burston, 1992). It is during this period of confusion and anxiety that the process of metamorphosis started to take place.

A surge of new software tool ideas have helped, including Enterprise Resource Planning (ERP) Supply Chain Management (SCM) (Chang, McFarlane, & Shaw, 2001); Customer Relationship Management (CRM) (Greenberg, 2002); electronic commerce (e-commerce) and procurement (Chang, Makatsoris, & Richards, 2004); extensions in order management, fulfillment, and demand lifecycle control (Makatsoris, Chang, & Richards, 2004a, 2004b; Makatsoris & Chang, 2004); electronic business (e-business) (CEC, 2000); and new forms of conducting business, among many others. Further, mobile devices have enabled access to systems and software from any place in the world, and these technological improvements are transforming the way people work. All of these have stimulated the reformation of business attitudes to the flow of goods, services, information, and knowledge (Hardwick, Spooner, Rando, & Morris, 1996; Richards, Dudenhausen, Makatsoris, & de Ridder, 1997; Bouet & Martha, 2000; Johnston, 2001; Introna, 2001; Zobel & Filos, 2002).

BACKGROUND

Life has become more hectic: the hustle and bustle of global business, developing everyday situations, and worldwide

instant news coverage have intermingled business with leisure more than ever before. Collaboration, especially e-collaboration, is very important for today's business. It can take place at any time between enterprises and organizations, and moreover can be between people who are located in different places around the globe. But people are different and are motivated in many different ways, as well as having to work in multi-tasking environments within a variety of e-collaboration activities. Understanding how to work effectively with others in modern industrial and service-oriented society is key.

To bring about real benefits to society and business, modern communication means will need to be improved, extended, and seamlessly integrated with support services that can speedily call upon suitable tools, models, data, information and knowledge, and visualizations of entities from anywhere and at anytime to match priority and context. These will be the new e-collaboration environments, or electronic collaborative working environments, that are human centered and intuitive for the practical use of people, teams, and heterogeneous groups in an enriched virtual world serving them in their everyday tasks.

THE VISION

An enterprise network in an e-business context must be considered holistically with respect to its scale and scope to enable better e-collaboration across all its nodes and enable efficient and sustainable operations (Ballesteros & Richards, 2006). However, understanding and embracing people's needs is critical to support human interaction in such working environments (CEC, 2005, 2006). This calls upon the development of better and newer forms of approaches that are in stark contrast to existing approaches and practice. The transformation process involves bridging the gap between the way people think and work with others with the emergence of virtual service-oriented collaborative working environments. The challenge though is to have more than just an intuitive interface. To be human centered is more about having the right services with responsive personalized features in a fully immersive virtual environment that must be designed and implemented with full involvement of the real users.

THE CHALLENGES

ICT tools and systems are important enablers (CEC, 2000) in enterprise management and the transformation processes taking place. They have played and will continue to play a major role in the emergence of new ways of conducting business and ensuring their sustainable development. However, open global standards, protocols and interfaces, interoperable applications and platforms, trusted and sustainable infrastruc-

ture, and compatibility between business practices must be developed before interconnection for broader-based business is fully realized (Frick & Lill, 2000; Kidd, 2001).

However, innovative ICT alone is not enough. The necessary social and organizational changes to business (McCarthy, 1996) are at least as significant and are enabled by ICT. For instance, a Web-like organizational network has emerged from the more loosely coupled supply chains of the 1990s. The adaptive value network (Makatsoris, 2004) and virtual enterprise permit new forms of communication, participation, leadership, and decision making to develop. In turn these create new economic balances, shared learning, and new procedures embracing human involvement rather than strict structures dictated by inflexible ICT, which would just collapse space and time (Franke, 2001; Duttas, 2001) and increase resistance to change that must be overcome (Hunziker & Sieber, 1999; Deloitte & Touche, 2000).

Three basic aspects to change have emerged, before smarter business is accomplished, to drive the change process. These are developing in parallel to carry business forward to the future.

- **Organization:** How organization and inter-company relations are developed to ensure greater collaboration—that is, working jointly together, cooperating, and coordinating; trusting each other; sharing information and knowledge where appropriate and refining the skills in the organization to cope with the economics, strategic aims; and increasing the rate of innovation, day-to-day operations, and service excellence.
- **Information and Communication Technologies:** How tools and systems are created, developed, and introduced to ensure open, effective, and efficient dynamic engagement between companies, using all the appropriate communication channels open to them as necessary and of preferred choice. This applies in business networks, supply chains, and value networks, as well as at the retail end where new opportunities may be found. Such opportunities include competencies and innovative products and services that can enable the creation, enlargement, or optimization of adaptive value networks. For example such tools include, among others: distributed planning, distributed event-driven decision assistance and tracking, demand lifecycle control, collaborative management of uncertainty and risk, and collaborative design and provision of an environment for context-based e-collaboration services which can rapidly switch the context of working on demand.
- **Environment:** How exclusivity may be stripped away to provide global trade opportunities for all in the world of electronic trade, not only buying but also selling to any region or nation irrespective of differences in

language, culture, or local laws or regulation. Also importantly when designing, making, distributing, and selling products, discovering how to ensure a sustainable development of business that balances economic growth with energy consumption and environmental impact.

Some of these challenges are outlined in Tables 1 to 3.

FUTURE TRENDS

Consolidation of ideas and rethinking of strategy has been enabled not only by a political will (Timmers, 2002; CEC, 2002) and further research and development (CEC, 2003; CEC, 2005), but also by the current global socio-economic, environmental, and energy trends as well as by a greater respect for the social and economic changes among all the industrial players.

ICT providers and consultants to date have provided much of the impetus for industrial change, but industry has now to fully engage with strategic plans to complete the transformation process. One of the challenges highlighted in

European statistics is that less than 20% of SMEs¹ had put in place any CRM or SCM software. Change through national incentives, joint projects, and education through regional clusters of companies in the same industry sector is being encouraged. However, it is now realized that technology cannot do it alone in the context of industry, business, and services. Both social and cognitive facets need to be fully understood and solutions found for deficiencies in order to create truly human-centered systems.

Europe, one of the world's largest trading blocks, has reconfirmed its Lisbon objective. The March 2005 European Council declared the aim of increasing the potential for economic growth and of strengthening European competitiveness by investing above all in knowledge, innovation, and human capital. This is reflected in other relevant and complementary work and objectives taking place in the Asian and American trading blocks. Current CEC research has provided many strategies for future manufacturing (Geyer, Scapolo, Boden, Dory, & Ducatel, 2003), e-collaboration (CEC, 2005), as well as delivering results for biometrics (IBG, 2003) of particular relevance to future authentication, and specific industrial supply chain innovations. Research initiatives, such as EC's Framework 7 with a focus on key information

Table 1. Some challenges to organization

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|---|
| <ul style="list-style-type: none"> • Lack of awareness by very large sections of the business community: <ul style="list-style-type: none"> ◦ How best to educate and train staff ◦ Provision of systems and interactive tools to encourage catalytic creative thinking • Lack of trust for successful e-business • Insufficient partners in an e-market — liquidity of an e-market • Lack of perceived benefit • Inequitable benefits: <ul style="list-style-type: none"> ◦ How benefits and risk are fairly shared • Lack of sustainable business models • Limitation of e-collaboration to low-tier suppliers • Needs to accelerate the business performance targets, for example: <ul style="list-style-type: none"> ◦ Reduction of 'time to market' ◦ Better precision for 'just-in-time production and logistics' ◦ Provision of faster innovation cycles ◦ Working capital efficiency ◦ Increased resource utilization across the whole network ◦ Improvements to distributed inventory and capacity management ◦ Creation of new metrics for value network performance improvement • Demand for specialty products in small batches through intelligent automated production planning and logistics systems • Demand for astute fast mobile complex service engineering • Inter-company e-collaborative design of high-quality complex products • Lack of standard models and metrics for e-collaboration • Lack of relevant support for people in multi-tasking jobs • Lack of ability to manage and control large equipment/product integration produced in value networks to meet the necessary performance targets • Needs to meet the demand of mass customization and personalization through detailed models and processes and smart, agile order processing • Ability of companies to conceptualize a value network that is advantageous to them and to identify requirements for new skills, new metrics, and changes to be made • Needs to have the ability to use shared knowledge and interpret shared information effectively among partners in a value network • How much transparency should be between partners in a value network • Belonging to many value networks at the same time • Lack of standard business processes |
|---|

Table 2. Some challenges for ICT

- Lack of a cost-effective and affordable, real-time worldwide communication of complex business information to serve the globally distributed nature of business
- Lack of interoperability between systems and applications
- Lack of appropriate multi-lingual facilities
- Lack of an affordable end-to-end high-quality seamless integration
- Lack of integrated workflow
- Free-flowing information flow in an end-to-end, timely, and secure manner
- Right economics for ICT suppliers
- Lack of smart applications and good decision assistance tools for collaborative business
- Need for data capture and filter systems that communicate in real time pertinent information to all partners in the value network
- Knowledge sharing and usage across the value network
- Cognitive decision making
- Tracking individual ordered products from source to consumer and providing a succinct record of such; the human food chain is a critical issue
- Development of intelligent agents as electronic proxies for individuals
- Serve the special needs of SMEs
- How to respond against unplanned/unexpected event with less cost
- Provision of an immersive environment that will automatically handle priorities by user choice, switch contexts of collaboration fast and in real time, and quickly provide all the necessary tools, data, information and knowledge, advanced visualizations to all involved in the collaboration process, and provide the means of management and administration for collaborations, which include new generation security measures and user choice IP protection
- Context orientation
- Intelligent lifecycle for both products and their demand support
- Integration methodologies and technology
- Provision of truly human-centered system
- Easy access to advanced simulators and computing power

Table 3. Some challenges for the business environment

- Too many standards developers and lack of coordination with sources of new work
- Slowness of standards take-up by commercial ICT developers
- Legal challenges:
 - Contract law
 - Cross-border provision of services
 - Protection of intellectual property rights
 - Privacy
 - Consumer protection
 - Electronic payments
- Regulation
- Security:
 - Trust
 - Cyber crime
 - Fraud
 - Unauthorized access
 - Computer attack
- Systematic framework to balance economic development with environmental and energy considerations

and communication technologies, will be a catalyst over the next few years for new working methods through the use of more innovative ICT and application. Other publications suggest that in the near future every single object will be connected to the Internet through a unique wireless address identifier allowing complete lifecycle tracking (Sarma, Brock, & Ashton, 2000; Murray, 2003; Datta, 2004). A roadmap for intelligent agent research is also available (SEEM, 2002).

Productivity is as much to do with people and organization than anything else, and a new way of thinking is highly desirable to deal with business survival and economics. New management styles that allow for greater flexibility and rapid smart responses and lifelong learning are essential to get right. Freeing up time is essential through proper prioritizations of all incoming messages, and events for pressures in the workplace are increasing, such as the overload from e-mail. Help from technology through personal electronic agents looking after both context and priority is one way of accomplishing this. Encouragement of effective and efficient collaboration too between people and mixed discipline teams within and without businesses will result in more creative thinking and help to increase the rate of innovation. Early studies and analysis of organizational webs (Tatnall & Gilding, 1999), value (Zobel & Filos, 2002), and inter-node relationships (Underwood, 2002) and new methodologies for design of networks (Soares, Sousa, & Barbedo, 2003), among many others, have helped to develop the social processes in complex organizations and their symbiosis with new business systems. And the Semantic Web will help to foster the much-needed greater understanding between organizations (Berners-Lee, 2001).

New people—known as the ‘gaming generation’—are already arriving at the workplace and are more used to working in virtual spaces that supplement the already diverse backgrounds, characteristics, and behaviors found.

CONCLUSION

Metamorphosis will not be completed over night; the transformation process will take many years before completed. It is expected that a new end state for global business is characterized by an expanding global economy, greater collaboration in smarter value networks, versatile virtual organizations, better deployment of knowledge, greater dynamism, versatility and unhindered opportunities in markets, highly dynamic processes, new standards of customer service excellence, better use of both capital and human resource, and better decision making. This will be brought about through better designed and correct deployments of ICT, for structured, trusted, and secure electronic exchanges between companies. How we procure software and services will change dramatically. Technological advances will continue unabated to feed the desires for improvement. Also applications and tools

will continue to improve with aids for helping organization building, revising or creating new inter-business processes, as well as providing aids for flexible sizing for smart e-collaboration value network configurations. Universal standards will make integration between applications and distributed databases and knowledge bases both easier and cheaper. And new telecommunications technology will improve both the speed and the volume of information flow per unit time from anywhere at anytime. The workforce and end customers will experience a new way of living and fulfillment with the help of human-centered systems. The basic novelty of our age is the spirituality of consumerism and voracious appetite for information. How these may be blended with an increasing capacity for sympathy and mutual understanding will inspire both ways of life and collaborative e-business.

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KEY TERMS

Adaptive Value Network (AVN): An arrangement where companies form a web of close relationships and work together as a system that delivers the right customized product and expected service at the right quality in a coordinated manner and are responsive and adaptable to changes in the environment (Makatsoris et al., 2004b).

Collaborative Working Environment: A virtual environment that allows seamless access to all the necessary services for the context of effective and efficient collaboration, and permits all people and teams involved that may be located in any global site and belong to any organization to be fully engaged. The highly distributed and integrated and connected resources are managed to provide fast context switching, IP protection, intuitive user interfaces, multimedia and smart assistance tools, and so forth.

Electronic Business (E-Business): Any form of business or administrative transaction or information exchange that is executed using information and communications technology. This may be transaction performed in a peer-to-peer fashion between companies or organizations or with a customer. Electronic business impacts the way business is perceived.

Electronic Market (E-Market): A market free from inhibiting constraints and affordable for all businesses in any shape, form, or size, and to allow them to easily take part in e-business with beneficial returns. It is a market in which trust, security, and dependability apply and in which regulatory and legal issues are unified. It is a market where buyers and sellers ubiquitously execute business transactions online. These may include searching and identifying competence; ability to identify the right product or service together with quality, price, and quantity; and virtual auctions. It is also based on an open, secure, and reliable collaborative platform for knowledge exchange, joint product design, production planning, and logistics in stable customer-supplier relationships.

Intelligent Software Agent: Acts at speed over the electronic communication channel on behalf of human individuals or companies as their proxy; a program acting on behalf of another person, entity, or process. An intelligent software agent is an autonomous program that is capable of perceiving and interpreting data sensed from its environment, reflecting events in its environment, and taking actions to achieve given goals without permanent guidance from its user. Agents must have the intrinsic ability to communicate, cooperate, coordinate, negotiate, and learn, as well as have the capability to evolve through interactions with other agents. Agents can be standalone or part of a multi-agent system.

Smart Organization: A further evolution of value networks and virtual corporations through the use of more advanced business models taking account of human ICT symbiosis and utilizing more intelligent applications and tools for collaborative work and holistic development of both product and service engineering.

Supply Chain: In its basic form, a buyer-centric chain or network of independent companies that are loosely interlinked by activity along a manufacturing, servicing, and distribution channel of a product service specialty, from sources of raw material to delivery to an end customer. Supplementary to this supply chain management is a set of approaches utilized to integrate suppliers, manufacturers, warehouses, retail stores, and so on. Consequently, merchandise is produced and distributed in right quantities, to right locations at the right time, to minimize system-wide costs while at the same time satisfying service-level requirements.

Value Network: This term is ambiguous, as the analytical perspective colors its meaning. Nevertheless, the value network in general terms evolves from a supply chain through mutual use of ICT and more closely linked collaboration and mutual dependency between the partner organizations or independent companies. Collaboration means electronic communication via extranet, or Internet, co-operation and co-ordination of work flow, information and knowledge exchange, negotiation and dynamic trading, and joint decision making. Value is derived through the exchanges with partner organizations in the network and its shared knowledge. The value network also aims to deliver the highest value to the end consumer and to its stakeholders.

Virtual Enterprise/Virtual Corporation: A virtual corporation or enterprise is formed from a pool of competencies and capabilities resulting from a club of pre-qualified partners that may be expanded or contracted through the mutual desires of the club. The management body for a virtual enterprise selects partners from the pool of competence available to provide products or comprehensive services to any industry in direct competition to single companies or other virtual enterprises. It is necessary to have strong collaborative relationships between partners in the club. The virtual enterprise may exist only on a temporary basis to take market chances, for example tendering. It may also exist for a longer term for optimization of a value network to service a market need.

ENDNOTE

- ¹ SMEs together with micro-companies account for 70% of employment in Europe.